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Evidence for the Photoionization Absorption Edge in a Photospheric Radius Expansion X-Ray Burst from GRS 1747-312 in Terzan 6

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Abstract

© 2018. The American Astronomical Society. All rights reserved. Thermonuclear X-ray bursts on the surface of neutron stars (NSs) can enrich the photosphere with metals, which may imprint photoionization edges on the burst spectra. We report here the discovery of absorption edges in the spectra of the type I X-ray burst from the NS low-mass X-ray binary GRS 1747-312 in Terzan 6 during observations by the Rossi X-ray Timing Explorer. We find that the edge energy evolves from 9.45 ±0.51 to ~6 keV and then back to 9.44 ±0.40 keV during the photospheric radius expansion phase and remains at 8.06 ±0.66 keV in the cooling tail. The photoionization absorption edges of hydrogen-like Ni, Fe, or an Fe/Ni mixture and the bound-bound transitions of metals may be responsible for the observed spectral features. The ratio of the measured absorption edge energy in the cooling tail to the laboratory value of the hydrogen-like Ni(Fe) edge energy allows us to estimate the gravitational redshift factor $1 + z = 1.34 \pm 0.11$($1 + z = 1.15 \pm 0.09$). The evolution of the spectral parameters during the cooling tail are well described by metal-rich atmosphere models. The combined constraints on the NS mass and radius from the direct cooling method and the tidal deformability strongly suggest very high atmospheric abundance of the iron group elements and limit the distance to the source to 11 ±1 kpc.

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Keywords

binaries: general, stars: neutron, X-rays: binaries, X-rays: individual (GRS 1747-312), X-rays: stars

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